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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

DETAILED ACTION

Election/Restrictions

In light of the amendment filed April 29, 2010, incorporating the method of claim 1 into the method of claim 24, the previous determination of unity is moot and the position regarding the "lack of unity" of the claims is withdrawn.

Claim Rejections - 35 USC § 112

1. **Claims 20 and 24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.**

2. Regarding Claim 24: The claim language utilizing subscripts often lacks antecedent basis and the if/then style of the claim in combination with the lack of any limitations surrounding the values of variables such as N renders claim 24 and its dependent claim 24 indefinite.

3. Specifically, "the thermal processing cycles A_n" is referred to without clear antecedent basis. Further, the term A_n in this first context appears to refer to multiple thermal processing cycles and later appears to refer to a single thermal processing step.

4. Further "BG_0" lacks sufficient antecedent basis such that it is unclear what interpretation is inteded. As all other elements of the form BG# refer to a band gap shift

resulting from a thermal processing step, it is unclear wether BG0 refers to a shift at all in line with all other BG elements or an initial band gap energy.

5. Additionally, as no limit has been palced on the values of N, the later recitations in the if/then form makes it unclear what value of N is required for the claim language. In other words, in the case where the process is asymetric, the language of the claims is consistent with a value of N=2 whereas where the process is symmetric at least N=3 appears to be required satisfy the claim language.

6. Stated in general terms, the lack of a clear claimed relationship between the sequences, the varaibles N, and the first and second thermal processing cycles/regions establisehed in claim 1 renders the scope of claim 24 nebulous and overall indefinite.

7. Lastly, as the line between the first and second thermal processing cycles from claim 1 and the A_n thermal processing cycles is unclear, it further is indefinite whether the samples claim 4 must be exposed during the same time as the substrate from claim 1 of if they should be exposed to a different yet comparable set thermal processing cycles.

8. Similarly, claim 20 is indefinte for for being dependent from in indefinite claim.

9. <u>Regarding Claim 20:</u> Claim 20 introduces language describing regions in the form "Nth region" without sufficient antecedient basis. As only two regions have been provided in independent claim 1, it is first unclear whether additional regions are being introduced to the claim language or if N only describes the two layers with antecedent basis. Further, "the smallest comulative band gap shift BG_1" is introduced without clear antecedent basis.

10. Further, though care has been taken to distinguish the elements BG and BG' associated with the first and second sample, but no distinction is made bewteen the first sample and the device of claim 1 such that it is indefinite whether three devices are required or only two.

11. Additionaly, it is unclear what is intended by “the N-1th region” in step (iii).

12. Lastly, as in claim 24, it is unclear from the if/then formation of the steps vi-ix whether the variable introduced for must be at least two or three in the same manner discussed above with respect to claim 20.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

13. **Claims 1, 5-6, 8-10, 13, and 16 are rejected under 35 U.S.C. 102(b) as being anticipated by Krauz.**

14. Regarding Claim 1, Krauz teaches:

A method for producing multiple quantum well intermixed (QWI) regions having different bandgaps on a single substrate, comprising the steps of:

a) patterning the surface of the substrate with QWI-initiating material (3 in Fig. 1b-1d) in first regions of the surface (such as left and right side as shown in Fig. 1d);

b) conducting a first thermal processing cycle (rapid thermal anneal; col. 4, liens 53-56) on the substrate to generate a first bandgap shift in the first regions (resulting bandgap shifts depicted in Figures such as 2a-2d);

c) patterning the surface of the substrate with QWI-initiating material in second regions of the surface (col. 5, lines 40-47 discusses repeat the patterning anneal pattern), distinct from said first regions; and

d) conducting a second thermal processing cycle on the substrate to generate a second bandgap shift in the second regions (col. 5, lines 40-47), and

to generate a cumulative bandgap shift in the first regions, the cumulative bandgap shift being the cumulative result of said first and second thermal processing cycles (first regions exposed to band gap shift as a result of both anneal steps required in at least col. 5, lines 40-47).

15. Regarding Claim 5, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above) in which

at least one of the thermal processing cycles comprises a rapid thermal anneal cycle (at least Fig. 2b).

16. Regarding Claim 6, Krauz teaches:

The method of claim 5 (see the rejection of claim 5 above)

in which all of the thermal processing cycles comprise rapid thermal anneal cycles (repeating taught in col. 5 lines 40-47 applied to rapid thermal anneal embodiment).

17. Regarding Claim 8, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above) in which

the QWI-initiating material comprises an impurity rich material (col. 3, lines 3-18 teaches silicon with doped with sulfur).

18. Regarding Claim 9, Krauz teaches:

The method of claim 8 (see the rejection of claim 8 above) in which

the impurity comprises one or more of sulphur (col. 4, lines 3-18), zinc, silicon, fluorine, copper, germanium, tin and selenium.

19. Regarding Claim 10, Krauz teaches:

The method of claim 8 (see the rejection of claim 8 above) in which

the impurity-rich material comprises silica (silicon dioxide taught in col. 5, lines 3-18) doped with one or more of the impurities sulphur (col. 5, lines 3-18), zinc, silicon, fluorine, copper, germanium, tin and selenium.

20. Regarding Claim 13, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above) in which

the QWI-initiating material from a given region is removed from the substrate after the first thermal processing cycle to which it is exposed and prior to a subsequent thermal processing cycle (etching taught in col. 5, lines 40-47).

21. Regarding Claim 16, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above)

used on an InP/AlInGaAs substrate (col. 4, lines 25-31 teaches "InGaAs/In(Ga)AlAs on InP substrates" thus providing both InP and AlInGaAs and is considered within the broadest reasonable interpretation of an InP/AlInGaAs substrate).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

22. **Claims 2-3, 14-15, 17-18, 20, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krauz.**

23. Regarding Claim 2, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above) further including the steps of:

Krauz fails to explicitly disclose:

e) patterning the surface of the substrate with QWI-initiating material in third regions of the surface, distinct from said first regions and said second regions; and

f) conducting a third thermal processing cycle on the substrate to:

(i) generate a third bandgap shift in the third regions,

(ii) generate a cumulative bandgap shift in the second regions, the cumulative bandgap shift in the second regions being the cumulative result of the second and third thermal processing cycles; and

(iii) generate a further cumulative bandgap shift in the first regions, the cumulative bandgap shift in the first regions being the cumulative result of the first, second and third thermal processing cycles.

Though Krauz only explicitly teaches two repetitions to "obtain in a controlled manner different degrees of localized transformation on a common quantum well medium" (col. 5, lines 40-47), it was known in the art at the time of the invention to manufacture a light emitting device with more than two wavelengths and it would have been obvious to one of ordinary skill in the art at the time of the invention to have performed an additional repletion of the etching and annealing taught in col. 5, lines 40-47 in order to manufacture a device capable of emitting additional wavelengths or as a mere obvious duplication (repetition) of a step from Krauz. Accordingly, a third thermal processing cycle is utilized, the first region will have a cumulative bandgap associated with all three annealing steps, the second region will be from the last two annealing steps, and the third region will only have been affected by a single anneal.

24. Regarding Claim 3, Krauz teaches:

The method of claim 2 (see the rejection of claim 2 above) further including the steps of:

Krauz as previously modified fails to explicitly disclose:

g) patterning the surface of the substrate with QWI-initiating material in other regions of the surface, distinct from all regions of the surface previously covered with QWI-initiating material; and

h) conducting a subsequent thermal processing cycle to generate a bandgap shift in the other regions, and to generate cumulative bandgap shifts in all regions previously covered with QWI-initiating material prior to the most

recent patterning step, the cumulative bandgap shifts each being the cumulative result of all thermal processing cycles to which the respective region has been exposed since being first covered with the QWI-initiating material.

As discussed above, it was known in the art to manufacture devices with multiple wavelengths (in this case 4). It would have been obvious to one of ordinary skill in the art at the time of the invention to have repeated the process discussed in col. 5, lines 40-47 thereby incorporating a fourth anneal in order to create a device capable of emitting at least 4 wavelengths or as a mere obvious duplication (repetition) of a manufacture step from Krauz. Accordingly, the additional repetition results in the first region being subjected to 4 anneals, the second region with three, and so on.

25. Regarding Claim 14, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above) in which

Krauz fails to explicitly disclose:

the QWI-initiating material on a given region is retained on the substrate for subsequent thermal processing cycles.

Though Krauz only explicitly teaches two repetitions to "obtain in a controlled manner different degrees of localized transformation on a common quantum well medium" (col. 5, lines 40-47), it was known in the art at the time of the invention to

manufacture a light emitting device with more than two wavelengths and it would have been obvious to one of ordinary skill in the art at the time of the invention to have performed an additional repletion of the etching and annealing taught in col. 5, lines 40-47 in order to manufacture a device capable of emitting additional wavelengths or as a mere obvious duplication (repetition) of a step from Krauz. Accordingly, a the sequence of local etching and subsequent annealing, meets the limitation requiring the QWI initiating material during subsequent anneals.

26. Regarding Claim 15, Krauz as previously modified teaches:

The method of claim 14 (see the rejection of claim 14 above) in which

the QWI-initiating material on a given region is retained on the substrate for all

subsequent thermal processing cycles (met by the method stopping after the third anneal discussed above).

27. Regarding Claim 17, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above)

Krauz fails to explicitly disclose:

in which each of the thermal processing cycles is performed for substantially the

same length of time.

Though Krauz fails to explicilty disclose the respective duratiosn for the repeated cycles discussed in col. 5, lines 41-47, it was known in the art to use a RTA time and it

would have been obvious to one of ordinary skill in the art to have chosen substantially similar durations in order to simplify the manufacture of the device. Alternatively, it as Krauz provides no motivation to alter the durations it would have been ovious "to try" a duration for the second anneal equal to the first anneal (MPEP §2141.III.E) or as an art recogniuzed duration suitable for the intended use of Krauz (MPEP §2144.07).

28. Regarding Claim 18, Krauz teaches:

The method of claim 17 (see the rejection of claim 17 above)

Krauz fails to explicitly disclose:

in which each of the thermal processing cycles is performed at different temperatures.

7

Krauz teaches repeating the etching and annealing, but doesn‘t discuss changing parameters between the repetitions. However, the graphs of Krauz showing the various relationships of the band-gap energy as a function of time demonstrates a by altering either the temperature of the durations control can be exercised over the final band-gap energy. It would have been obvious to one of ordinary skill in the art at the time of the invention to have varied the temperature used in the anneals as a mere selection of an art-recognized anneal parameter (suitable for affecting the final band gap of the device) to vary in order to be able to control the final relative band gap of the regions of the device.

29. Regarding Claim 24, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above),

wherein the thermal processing cycles An are ones of a plurality of thermal processing cycles A_1-A_n and wherein the cumulative bandgap shift BG_n is one of a plurality of cumulative bandgap shifts BG_1-BG_N, (at least col. 5, lines 40-47 discusses multiple anneals and the anneals are shown to affect the band gap shifts)

Krauz fails to disclose:

the method further comprising the steps of:

prior to said step of patterning the surface of the substrate with QWI-initiating material in first regions of the surface,

determining whether the process for generating cumulative bandgap shifts resulting from successive thermal processing cycles is symmetric or asymmetric;

if the process is symmetric,

determining thermal process conditions required for each one of the plurality of cumulative bandgap shifts BG_1 BG_N by successively thermally processing at least one sample through the thermal process sequence A_N to A_1,

where A_1 is the thermal process required to obtain BG_N from BG_0;

A_2 is the thermal process required to obtain BG_{N-1} from BG_{N-2}; etc.;

through to A_N being the thermal process required to obtain BG_1 from BG_0;

and

if the process is asymmetric,

determining the thermal process conditions required for each one of the plurality of cumulative bandgap shifts BG_1 to BG_N by partially or completely thermally processing a plurality of samples through a sequence in the order A_1 to A_N for each one of the bandgap shifts required.

Krauz teaches forming a device in accordance with the method of claim 1, but is silent as to any preliminary sample testing and decisions surrounding symmetry. However, Krauz demonstrates the rapid thermal anneal step results in a predictable relationship between the band-gap and the duration (at least Fig. 2b). Accordingly, the selection to repeat the process (col. 5, lines 40-47) results in a symmetric sequence of two anneals. Further, the data points at all the various durations shown in at least Fig. 2b suggests, many different samples were tested in the development of the device according to Fig. 1a-1e. Lastly, as the thermal treatments of Krauz are the same (i.e. repetition) the process conditions are reversible such that the sequence of 1 then 2 and 2 then 1 is indistinguishable and is sufficient to meet the language of the symmetric conditional. As it was known in the art at the time of the invention to produce a device as a result of measuring and testing devices before it in order to optimize the final product, it would have been obvious to one of ordinary skill in the art at the time of the

invention to have determined the process was symmetric with respect to duration and band gap and to have process a sample utilizing determined parameters in order to test or measure the device prior to producing final copies.

30. Regarding Claim 20, Krauz teaches:

The method of claim 24 (see the rejection of claim 24 above) further comprising the steps of:

Krauz fails to explicitly disclose:

(i) establishing thermal processing conditions A_N suitable for obtaining the smallest cumulative bandgap shift BG_1 of the Nth region;

(ii) performing a thermal processing cycle on a first sample using A_N to obtain bandgap shift BG_1;

(iii) establishing thermal processing conditions A_{N-1} suitable for obtaining the cumulative bandgap shift BG_2 of the N-1th region;

(iv) performing a thermal processing cycle on said first sample, after step (ii), using A_{N-1} to obtain bandgap shift BG_2;

(v) performing thermal processing cycles A_{N-1} then A_N on a second sample to obtain bandgap shift BG_2';

(vi) establishing whether the anneal process is symmetric, i.e., if $BG_2 = BG_2'$, and if so performing steps (vii) to (viii), otherwise performing step (ix);

(vii) establishing thermal processing conditions A_{N-2} suitable for obtaining the cumulative bandgap shift BG_3;

(viii) performing a thermal processing cycle on said first sample, after step (iv), using A_{N-2} to obtain bandgap shift BG_3;

(ix) establishing cumulative thermal processing cycles A_1 to A_N for each one of the cumulative bandgap shifts BG_N to BG_1 on separate samples for each one of the cumulative bandgap shifts required.

Krauz as previously modified in claim 24 established the idea that it would have been obvious to have manufactured/measured/tested additional preliminary device (samples) during the research and manufacturing of the device of Fig. 1a-1e. Re. Claim 20, Krauz teaches multiple data points on graphs such as 2b demonstrating the relationship between duration and energy gap from rapid thermal anneals. In at least this sense, multiple samples can be said to have been exposed to the thermal treatments of the reference. However, Krauz is silent as to exposing any sample to the sequence of both a first and second anneal (repeated anneal). Further, as discussed in claim 24, it would have been obvious to one of ordinary skill in the art to have performed the thermal processing (anneals) of Krauz on samples prior to the manufacture of the final device as in order to manufacture prototypes to measure and test in order to optimized the method of producing the final device. As discussed in claim 20, as the anneals selected from Krauz are taught as repetitions, it would have been obvious to one of ordinary skill in the art at the time of the invention to have selected comparable time and temperature parameters such that the order of the anneals is symmetric and indistinguishable.

31. **Claims 4 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krauz in view of Chino.**

32. Regarding Claim 4, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above) further including

Krauz fails to explicitly disclose:

the step of covering adjacent regions of the substrate not covered with QWI-initiating material with QWI-inhibiting material.

It was know in the art, as demonstrated by Chino to manufacture light emitting devices in an array of pixels for use in macroscopic devices. Further, Chino teaches insulating the pixels form on another using a using a boundary insulation film (at least ¶31). Further, conventional insulating films would not be doped in the manner required by the QWI-initiating layer and thereby are sufficient to be considered QWI-inhibiting layers. It would have been obvious to one of ordinary skill in the art at the time of the invention to have manufactured a plurality of devices according to figures 1a-1e of Krauz on a common substrate and to have separated them with a insulating layer in a conventional manner in order to produce a macroscopic array of pixels according to Krauz's invention.

33. Regarding Claim 12, Krauz as previously modified by Chino teaches:

The method of claim 4 (see the rejection of claim 4 above) in which

Krauz as previously modified by Chino fails to disclose:

the QWI-inhibiting material comprises a PECVD-silica layer.

Chino teaches boundary insulating film 24 helping to insulate adjacent pixels (Fig. 5) but fails to explicitly disclose the material of the deposition technique. It was known in the art to insulate adjacent electronic devices with silica and to manufacture silica using a PECVD method. I would have been obvious to one of ordinary skill in the art at the time of the invention to have selected silica as a mere selection of an art-recognized insulating material suitable for the intended use of Krauz as previously modified by Chino (MPE §2144.07) and it further would have been obvious to one of ordinary skill in the art at the time of the invention to have manufacture the silica layer with a PECVD step as a mere selection of an art-recognized deposition technique suitable for the intended use of Krauz as modified by Chino.

34. **Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Krauz in view of Andrade and Hidaka.**

35. Regarding Claim 7, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above) in which the steps of patterning regions of the substrate with QWI-initiating material comprises the steps of:

Krauz fails to explicitly disclose:

depositing photoresist on the substrate;

forming windows in the photoresist coextensive with the region of the substrate to be covered with QWI-initiating material;

depositing the QWI-initiating material onto the substrate; and

lifting the photoresist off the substrate.

Though, Krauz teaches the patterning is done by etching, it was known in the art that a lift-off process is a suitable means to deposit a patterned layer. See, for example, Andrade who teaches the patterned layers can all be formed by etching of lift-off (col. 3, lines 38-48). However, Andrade fails to explicitly disclose the sequence including a photoresist. Hidaka teaches the sequence of depositing a photoresist leaving the areas where silicon dioxide will reside open followed by the deposition of the silicon dioxide and the lift off of the photoresist and the silicon dioxide over the photoresist (sequence of Fig. 2-3; ¶20-22). It would have been obvious to one of ordinary skill in the art at the time of the invention to have selected a lift-off process utilizing a photoresist as taught by Hidaka as a mere substitution of an art-recognized method of providing a patterned layer suitable for the intended use of Krauz (MPEP §2144.07)

36. **Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Krauz in view of Fraas.**

37. Regarding Claim 11, Krauz teaches:

The method of claim 1 (see the rejection of claim 1 above)

Krauz fails to explicitly disclose:

in which the QWI-initiating material is sputter deposited.

Fraas teaches that it was known in the art at the time of the invention to provide a doped silicon dioxide layer via a sputter deposition method (Fig. 7A; col. 6, lines 50-60; claim 34). It would have been obvious to one of ordinary skill in the art at the time of the invention to have selected a sputter deposition technique to form the doped silica layer of Krauz as a mere selection of an art-recognized deposition technique suitable for the intended use of Krauz (MPEP §2144.07)

Contact

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allen L. Parker whose telephone number is (571)270-5841. The examiner can normally be reached on Monday-Friday 7:30am-5:00pm EDT.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Davienne Monbleau can be reached on (571)272-1945. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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ALP

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Primary Examiner
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